

# A COSPAR/International Living With a Star (ILWS) Roadmap Towards Advanced Space Weather Science to Protect Society's Technological Infrastructure

presented by Karel Schrijver

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- Takahiro Obara; Tohoku University, Japan
- Paul O'Brien; Aerospace Corporation, USA
- Terry Onsager; NOAA Space Weather Prediction Centre, USA
- Hermann Opgenoorth; Swedish Institute of Space Physics, Sweden
- Karel Schrijver, chair; Lockheed Martin, USA
- Michael Terkildsen; IPS Radio and Space Services, Australia
- Cesar Valladares; Boston College, USA
- Nicole Vilmer; LESIA Observatoire de Paris, France



# COSPAR/ILWS charge to the roadmap team

'The goal of the study is to formulate and establish, in the form of a Roadmap, the future research focus and related missions in this field of science. A role model for this study can be found in a similar exercise led by the COSPAR Scientific Commission on Research in Astrophysics from Space on "The Future of Space Astronomy."

'The study will extend over the course of approximately one year, and the group is expected to conclude its activities by August 2014, in time for presentation of a draft report to the 40th COSPAR Scientific Assembly in Moscow.'

The COSPAR Panel on Space Weather formulated the following expectations:  
The roadmap would cover as minimum:

- Currently available data, and upcoming gaps
- Agency plans for space based space weather data (national and international): treating both scientific and monitoring aspects of these missions.
- Space and ground based data access: where current data is either proprietary or where the geographic location of the measurement makes data access difficult
- Current capability gaps which would provide a marked improvement in space weather service capability.

The outcome should centre on a recommended approach to future developments, including coordination and addressing at least:

- ▶ Key science challenges
- ▶ Data needs, space and ground based
- ▶ Smooth and organised transition of scientific developments into reliable services

# *Schedule*

- Team appointed in spring 2013
- 1st team meeting at COSPAR HQ in Nov. 2013
- 2nd team meeting at US SWW, April 12-14, 2014
- Presentation of draft roadmap at COSPAR, Moscow
- Final text formulated in fall 2014, and submitted for publication in late fall 2014



# Help us help you

- Please provide input on the distributed questionnaire and return by the end of this meeting. Thank you!

## HELP US HELP YOU: PLEASE SUPPORT THE COSPAR SPACE WEATHER ROADMAP ACTIVITY!

The Committee on Space Research (COSPAR) Panel on Space Weather and the International Living With a Star (ILWS) organization are developing a roadmap for space weather ([www.lmsal.com/~schryver/COSPARrm/](http://www.lmsal.com/~schryver/COSPARrm/)). The goal of this roadmap is to formulate and establish the future research focus and related missions to advance space weather.

Your input will be helpful to focus the roadmap recommendations on the needs of space weather service users and service providers.

Please fill out the sections that pertain to you and return this form to the registration desk by Friday noon. The roadmap team will be meeting in Boulder after Space Weather Workshop and will use this information in producing its report.

### As a (potential) space weather service or product user

Why is it important for you to have space weather information?

How do you use space weather services or products?

How could these services or products better satisfy your user needs?

Which products or services are currently missing or under-developed?

### As a (potential) space weather service or product developer/operator

Which services or products do you develop/operate?

Which user community do you serve and how do you interact with (potential) users?

What would you need to improve your products?

### Any other comments, recommendations, questions

#### Personal information (optional)

Name

E-mail

Area of expertise

Please consult our on-line space weather resource catalogue at <http://www.spaceweathercatalogue.org/>. We invite you to enter information on resources that are not yet listed.

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# *Findings*

The RoadMap summarizes its findings in three key areas:

- A) Observational, computational, and theoretical capabilities and needs
- B) Development of a coordinated collaborative research environment
- C) Shaping conditions for effective coordination between agencies and between research and customer communities.

# *Requirements*

Hierarchical formulation of requirements:

- Key research questions to be addressed to make demonstrable advances in understanding the space environment and the space weather services derived from that.
- Research methodologies required to effectively address those key research questions.
- Specific crucial observables, models, data infrastructures, and collaborative environments that enable those research methodologies.



# *Identifying requirements*

The roadmap illustrates the key research areas that promise to advance both our understanding of space weather and the quality of space weather services by tracing phenomena through three, largely complementary, classes of impacted systems and activities:

- I. Electrical power (via GIC)
- II. Positioning and navigation (via transionospheric signals)
- III. Space-based assets (via energetic particles, incl. S/C charging)
- IV. ...

The roadmap assesses impacts throughout the range of space conditions, including both the relatively frequently experienced states of space weather and its rare extremes.



# Tracing & predicting space weather conditions

Legend:  
 Shading in red: priority interests.  
 Required observables or models:  
 space, heliospheric, geospace

**I** User priority  
 Currently a weak (obs. or model) link  
**W** Opportunity for improved understanding and services.  
**O**

**GMD/GIC**  
 (I)CME

Most significant use: protection of electrical/electronic systems

**Nav./Comm.**  
 Trans-ionospheric signals

Most significant use: (near-)real time positioning and navigation

**Space assets**  
 SEP & RB electrons, ions

Most significant use: post-facto NRT satellite anomaly resolution, and design specs

2 days

1/2 hour

5 min.

Current conditions

Archive of past conditions

Extreme-event properties

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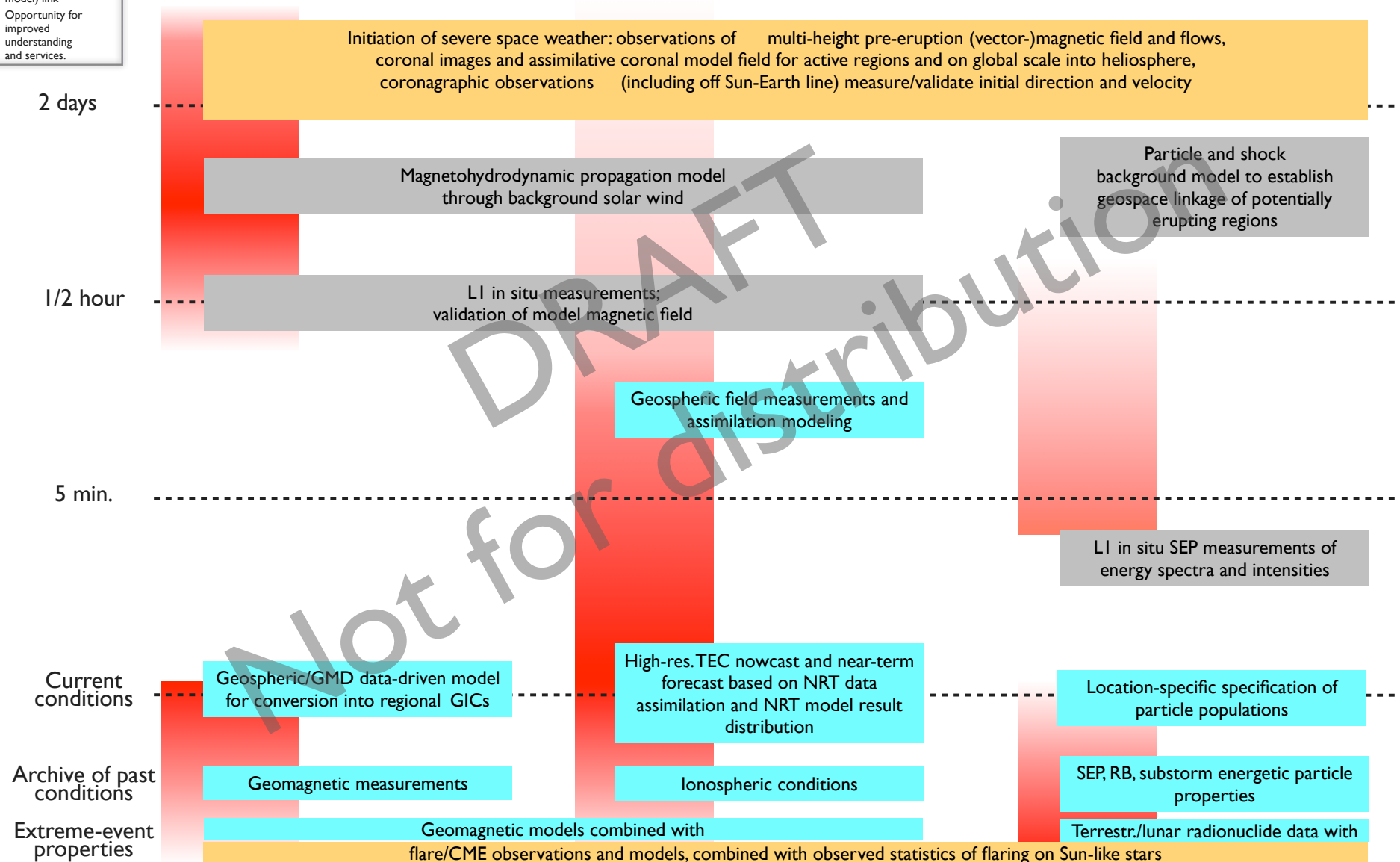
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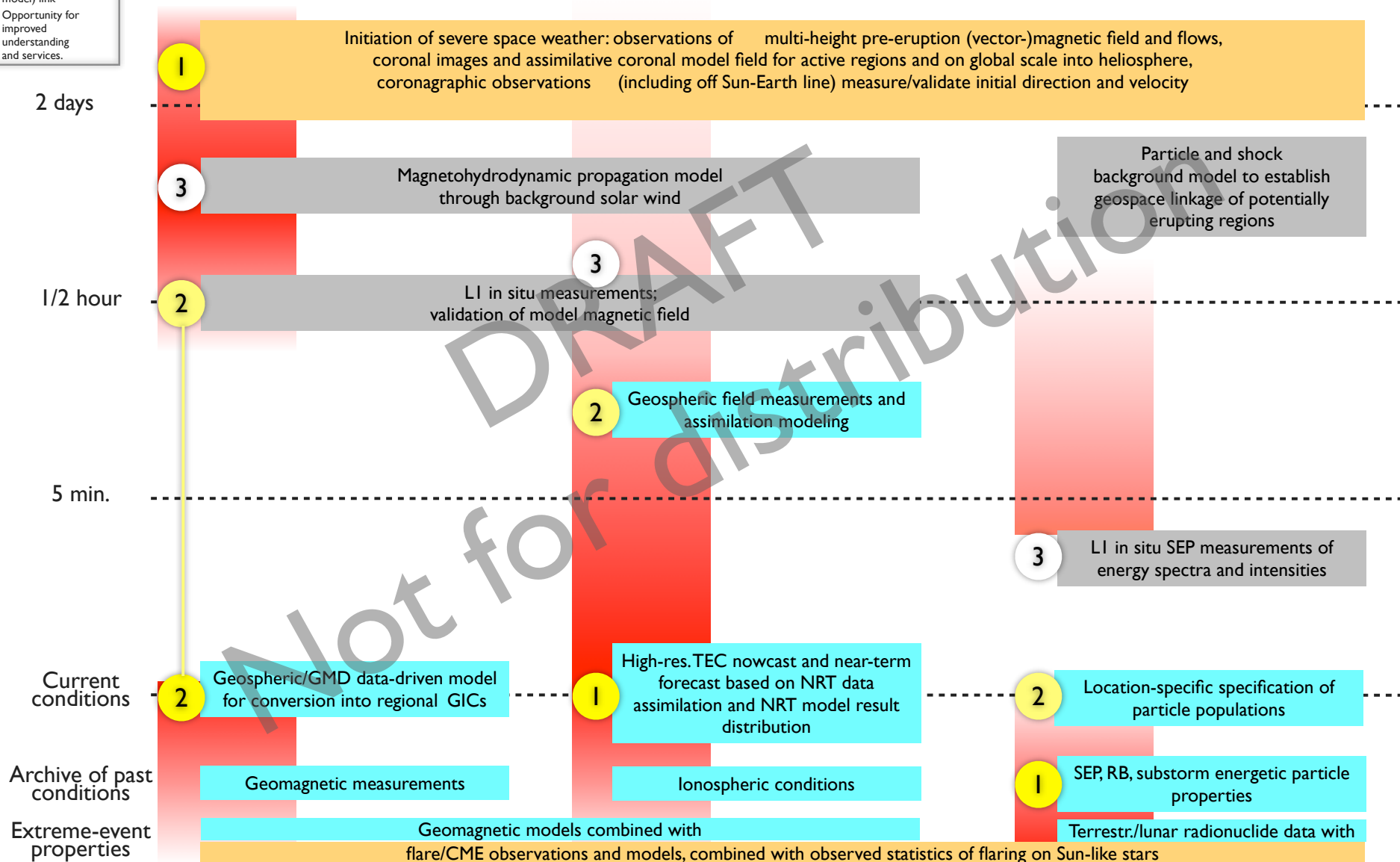
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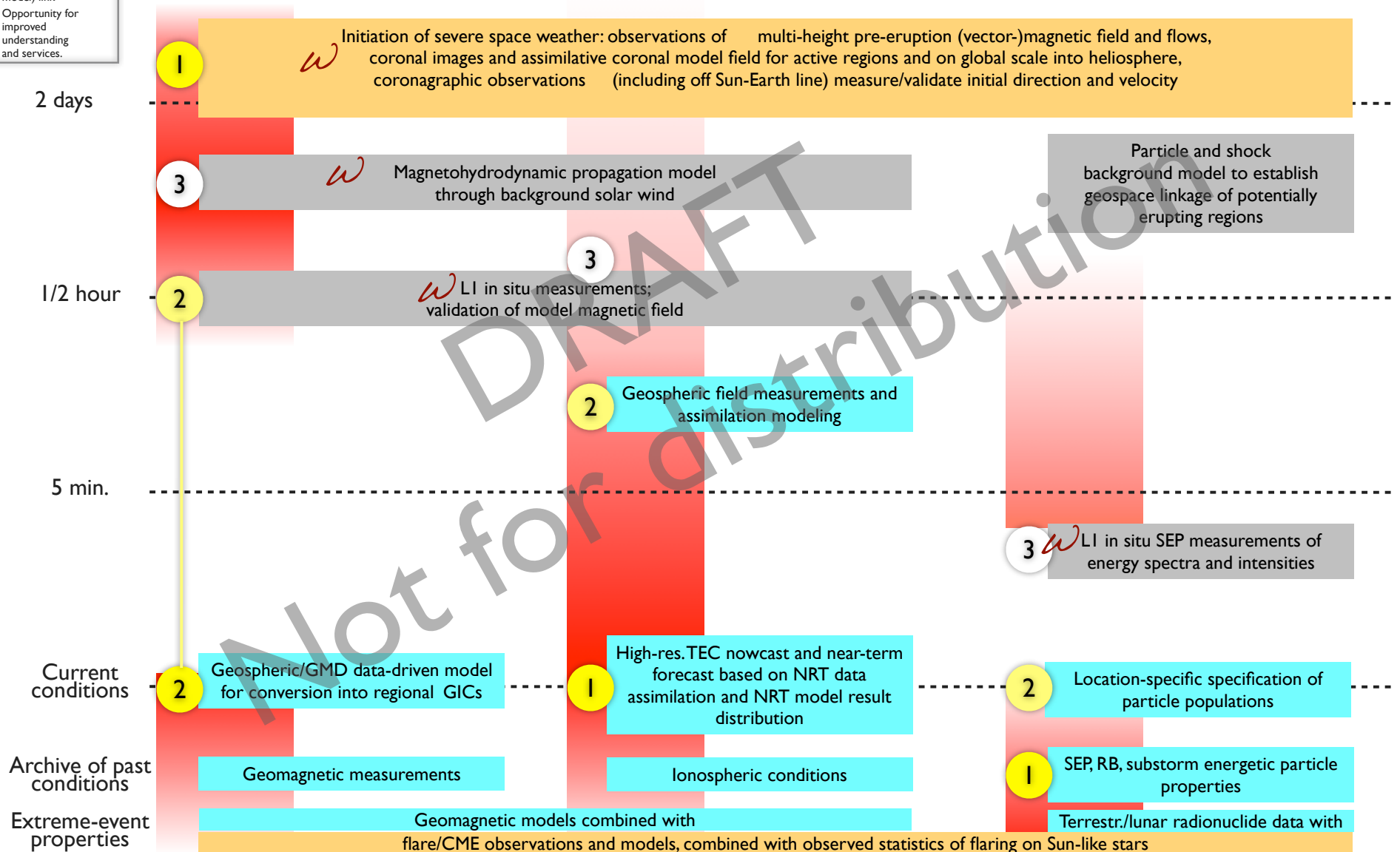
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